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DATE
27 JANUARY 2019

ENERGY AND SUSTAINABILITY STATEMENT

OWNER OCCUPIER
79 AVENUE ROAD,
ST JOHN'S WOOD,
LONDON NW8 6JD

Design Team:

RPS Group – Planning Consultant

RPS Group – Acoustic Consultants

KSR Architects – Architects

Mira A-Architecture & Engineering Ltd

Form SD – Structural Engineers, Flood Risk Consultants, SuDs and Basement Impact Assessment.

Calfordseaden – Daylight and Sunlight

Cantia Arboricultural – Arboricultural Consultants

Integration – M&E Engineers

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DOCUMENT STATUS

PROJECT
79 Avenue Road, St Johns Wood
London, NW8 6JD

PROJECT NO.
581

CLIENT
Owner Occupier
79 Avenue Road,
St Johns Wood,
London
NW8 6JD

IN CONJUNCTION WITH
RPS Group – Planning Consultant

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KSR Architects – Architects

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REVISION	STATUS	CHECKED	DATE
0	Issue	Alan Harries	6.12.2019
1	Issue	Alan Harries	11.12.2019
2	Issue	Alan Harries	17.12.2019
3	Issue	Alan Harries	18.12.2019
4	Issue	Alan Harries	27.01.2020

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CONTENTS

EXECUTIVE SUMMARY

This Energy Assessment and Sustainability Statement has been prepared by Integration Consultancy Limited in support of the planning application for the proposed development at 79 Avenue Road in the London Borough of Camden. The project comprises the demolition of the existing residential dwelling and the redevelopment for a single residential dwelling with basement.

Energy and Sustainability Achievements

In line with the London Plans zero carbon residential target, the new dwelling has been shown, via approved methodologies, to achieve:

- 45.4% improvement in carbon dioxide (CO_2) emissions over the Target Emission Rate outlined in the national Building Regulations 2013 compared to the target of 35%.
- Renewable energy deployment meeting 45% of the CO_2 emissions associated with the development's regulated energy demand compared to the target of 20%.

The existing building has an EPC rating of F (see Appendix A). This is very low and in the bottom 3% of all registered properties. The new scheme would involve a radical fabric and systems upgrade in terms of energy and, as a result, would be in the top 8% of dwellings in England and Wales.

EPC RATING	A / B	C	D	E	F / G
Number of dwellings in England / Wales	5,017	17,707	28,198	9,217	1,917
% of dwellings in England / Wales	8.02%	28.3%	45.1%	14.7%	3.1%
79 Avenue Road	Proposed	←			Current

Table 1: EPC rating for proposed scheme and existing building compared to properties England & Wales, Nov 2019

The proposed scheme achieves this via the following strategies:

Be Lean – Energy Efficiency

The scheme uses high performance building fabric and low energy building services systems. For example, following the *passivhaus* approach, mechanical ventilation with heat recovery (MVHR) and air tightness and insulation better than building regulations notional building (e.g. walls 0.13 W/m^2/°C and low air permeability (3 m^3/m^2/h @ 50Pa). The dwelling also benefits from a central atrium to allow for stack-assisted ventilation, night cooling and daylight penetration into the core of the building.

The proposed "Be Lean" design elements have been shown to achieve a 0.1% reduction in CO_2 emissions compared to Building Regulations 2013.

Be Green - Local Renewable Energy

Following a Low and Zero Carbon (LZC) Technology feasibility study it is proposed to provide a ground source heat pump supported by a 6.3 kWp PV modules located at roof level.

The proposed "Be Green" design has been shown to achieve an additional 45.3% reduction compared to Building Regulations 2013.

A rainwater harvesting or grey water collection will be included for WC flushing and irrigation as well as low flow taps, showers, WCs and dishwashers / washing machines to meet the higher water use target of 105 litres / person / day or less (excluding an allowance of 5 litres or less per head per day for external water consumption). The residence also benefits from very good links to low energy public transportation, e.g. Swiss Cottage and South Hampstead stations (the site achieves a high PTAL score of 4). Extensive green roofs area are also provided on lower level roofs.

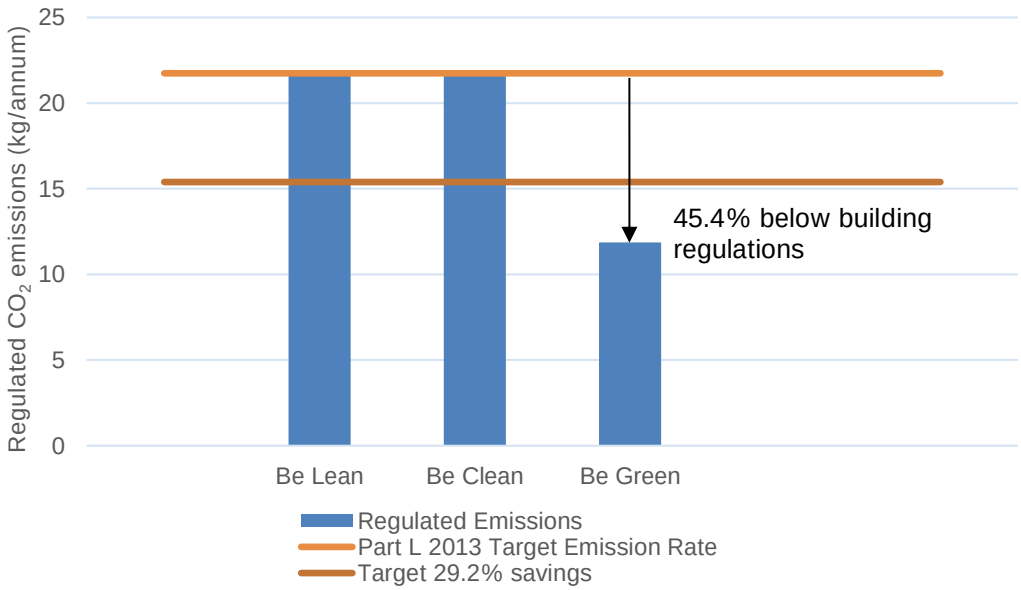


Figure 1: Summary of the dwelling regulated energy use as compared to the CO_2 emission baseline

The table below shows the regulated and unregulated energy use for the new dwelling.

	Carbon dioxide emissions for dwellings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 (Building Regulations) Compliance	21.74	20.44
After "Be Lean" (energy demand reduction)	21.73	20.44
After "Be Clean" (heat network / CHP)	21.73	20.44
After "Be Green" (renewable energy)	11.87	20.44

Table 2: Dwelling regulated CO2 emissions after each stage of the Energy Hierarchy

This performance can be expressed as savings between each stage in the energy hierarchy.

	Regulated carbon dioxide savings (Tonnes CO_2 per annum)	(%)
Savings from "Be Lean" (energy demand reduction)	0.02	0.1%
Savings from "Be Clean" (heat network / CHP)	0.00	0.0%
Savings from "Be Green" (renewable energy)	9.86	45.3%
Total cumulative on-site savings	9.87	45.4%
Shortfall to 35% below Part L (annual)	11.87	
Shortfall over 30 years	356	
Carbon Offset Fund (@£60/tonne[1])	£ 21,371	

Table 3: Dwelling regulated CO_2 emissions savings after each stage of the Energy Hierarchy.

[1] "From October 2016…the Council considers £1,800 per tonne of carbon (30 years) to be appropriate (both residential and non-residential development)"

1 INTRODUCTION

Integration Consultancy Limited has been appointed to undertake an Energy and Sustainability Assessment in support of the full planning application for the proposed scheme at 79 Avenue Road in Camden, London. The report is one of several that accompany the planning application and should be read in conjunction with these documents.

The importance of developing a robust well-considered energy and sustainability strategy cannot be overstated. This strategy sets out the roadmap for the entire project and ultimately the success of the strategy will translate into the success of the building's performance on practical completion and throughout its lifecycle.

Underpinning the energy strategy is the 'Be Lean', 'Be Clean' and 'Be Green' design framework which has been widely adopted (e.g. in the London Plan).

1. 'Be lean' (energy demand minimisation through 'passive' and 'active' design measures)
2. 'Be clean' (efficient energy supply)
3. 'Be green' (renewable energy generation where feasible)

This report sets out the scheme's energy and sustainability aspirations and demonstrates, via the approved calculation methodologies, how these will be achieved through the detailed design and construction stages.

As part of this exercise, the feasibility of implementing a variety of low carbon technologies and renewable energy systems is considered based on aspects such as site location and climate, potential carbon savings, economic viability, environmental impacts and practical aspects such as integration and maintenance considerations.

THE DEVELOPMENT SITE

The site is located at 79 Avenue Road, St John's Wood, London HA1 1ES. The site has a very good low-carbon public transportation links achieving a PTAL score of 4 (public transport access levels).

Figure 2: Site location and public transport access levels rating

Figure 3: Aerial view of site

PROPOSED DEVELOPMENT OVERVIEW

The proposed scheme involves the demolition of the existing residential dwelling and the redevelopment for a single residential dwelling with basement. The existing building has an EPC rating of F (see Appendix A). This is very low and in the bottom 3% of all registered properties. The new scheme would be involve a radical fabric and systems upgrade in terms of energy and, as a results, would be in the top 8%.

EPC RATING	A / B	C	D	E	F / G
Number of dwellings in England / Wales	5,017	17,707	28,198	9,217	1,917
% of dwellings in England / Wales	8.02%	28.3%	45.1%	14.7%	3.1%
79 Avenue Road	Proposed	◄			Current

Table 4: EPC rating for proposed scheme and existing building compared to properties England & Wales, Nov 2019 [2]

Figure 4: Proposed development

ENERGY AND SUSTAINABILITY ASPIRATIONS

As a "minor" development, the scheme has adopted energy and sustainability targets in line with the national and local policy as detailed in section 2.

Low emissions: The scheme aims to aligns itself with the main London Plan / GLA energy target of zero carbon residential development by substantially bettering the Building Regulations Part L requirements and target of 35% below part L.

Local Renewable Energy: The development aims to meet the London Plan target for a minimum of 20% of CO_2 emissions associated with the development's regulated energy demand to be met by renewable energy systems.

Low Water Use. The scheme adopts the aspiration water-use target of 105 litres / person / day or less (excluding an allowance of 5 litres or less per head per day for external water consumption).

[2] www.gov.uk/government/statistical-data-sets/live-tables-on-energy-performance-of-buildings-certificates#epcs-for-all-domestic-properties-existing-and-new-dwellings

2 POLICY REVIEW

NATIONAL PLANNING POLICY FRAMEWORK (NPPF – FEB 2019)

Section 14 of the NPPF relates to the challenge of climate change and flooding. Of particular relevance is paragraph 148 which supports the move to a low carbon future and states:

The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to:

- shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience;
- encourage the reuse of existing resources, including the conversion of existing buildings;
- and support renewable and low carbon energy and associated infrastructure

LONDON PLAN

Regional policy in London is controlled by The Greater London Authority and is set out in The London Plan adopted in March 2016. The Plan sets out policy and guidance in the London context and identifies a number of objectives related to improving London as a workplace and living place. Additional guidance is provided by "Energy Planning, Greater London Authority guidance on preparing energy assessments" (March 2016).

The dominant condition stipulated in terms of energy and sustainability is for all major developments to achieve at least a 35% reduction in regulated carbon dioxide emissions beyond the minimum targets stated in Part-L 2013 of the Building Regulation.

For major residential accommodation developments, the London Plan has adopted "Zero Carbon" from 1st October 2016. The remaining regulated carbon dioxide emissions to 100% are to be off-set through a cash-in-lieu contribution to the local borough to secure delivery of carbon dioxide savings elsewhere.

In addition, The London Plan states that all major development proposal will seek to reduce carbon dioxide emissions by at least 20 per cent through the use of on-site renewable energy generation wherever feasible.

The concept of sustainable development is cardinal to all policies within the London Plan which covers areas such as Places, People, Economy, Response to Climate Change, Transport, and Living Places and Spaces. Chapter 5 of the London Plan sets out a range of policies in relation to climate change, including climate change mitigation and adaptation, waste, aggregates, contaminated land and hazardous substances.

Key policies within the London Plan applicable to the proposed development are:

POLICY 5.2 -MINIMISING CARBON DIOXIDE EMISSIONS

Planning Decisions

A Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

1 Be lean: use less energy

2 Be clean: supply energy efficiently

3 Be green: use renewable energy

B The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Residential Buildings:

Year	Improvement on 2010 Building Regulations
2016 – 2031	Zero carbon (from 1 October 2016)

C Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy.

D As a minimum, the energy assessment should include the following details:

a) calculation of the energy demand and carbon dioxide emissions covered by Building Regulations and, separately, the energy demand and carbon dioxide emissions that are not covered by the Building Regulations at each stage of the energy hierarchy

b) proposal to reduce carbon dioxide emissions through the energy efficient design of the site, building and services

c) proposals to further reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP).

d) proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.

E The carbon dioxide reduction targets should be met on-site. Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, any shortfall may be provided off-site or through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

POLICY 5.7 – RENEWABLE ENERGY

5.42 There is a presumption that all major development proposals will seek to reduce carbon dioxide emissions by at least 20 per cent through the use of on-site renewable energy generation wherever feasible.

The London Plan states that "This approach will also help ensure that the development industry in London is prepared for the introduction of 'Nearly Zero Energy Buildings' by 2020" (as required by the European Energy Performance of Buildings Regulation which requires periodic review of Building Codes to ensure cost optimal review of energy efficiency standards and that all new buildings are 'nearly zero energy buildings' by 2020).

The "Energy Planning, Greater London Authority guidance on preparing energy assessments", provides the definition of Zero Carbon:

ENERGY PLANNING. Greater London Authority guidance on preparing energy assessments

Definition

5.3 'Zero carbon' homes are homes forming part of major development applications where the residential element of the application achieves at least a 35 per cent reduction in regulated carbon dioxide emissions (Beyond Part L 2013) on-site. The remaining regulated carbon dioxide emissions, to 100 per cent, are to be off-set through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere (in line with policy 5.2E).

Other key policies within the London Plan applicable to the proposed development and addressed in this report are:

5.3 – Sustainable Design & Construction

This provides guidance on issues related to air pollution and minimum emission standards for combustion plant.

5.3 – Sustainable Design & Construction

Emissions standards have been developed based on the latest technology, viability and the implication for carbon dioxide emissions of any abatement measures to reduce the NOx and PM10 emissions from the plant. The emission standards are provided in Appendix 7 and target minimum standards. Plant proposed within developments is to comply with these standards, in addition to the development meeting the overall 'air quality neutral' benchmarks.

- 5.6 – Decentralised Energy in Development Proposals
- 5.8 – Innovative Energy Technologies
- 5.9 – Overheating & Cooling

This section states that Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the cooling hierarchy.

- 5.15 – Water Use & Supplies

This provides additional guidance on water consumption:

5.15 – Water Use & Supplies

5.61 Residential development should be designed so that mains water consumption would meet a target of 105 litres or less per head per day, excluding an allowance of 5 litres or less per head per day for external water use. This reflects the 'optional requirement' set out in Part G of the Building Regulations.

CAMDEN LOCAL POLICY

Policy CC1 - Climate change mitigation

We will:

a. promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;

b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;

c. ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;

d. support and encourage sensitive energy efficiency improvements to existing buildings;

e. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and f. expect all developments to optimise resource efficiency.

8.6 The Council's Sustainability Plan 'Green Action for Change' commits the Council to seek low and where possible zero carbon buildings

8.11 The Council will expect developments of five or more dwellings and/or more than 500 sqm of any gross internal floorspace to achieve a 20% reduction in carbon dioxide emissions from on-site renewable energy generation (which can include sources of site related decentralised renewable energy), unless it can be demonstrated that such provision is not feasible. This is in line with stage three of the energy hierarchy 'Be green'. The 20% reduction should be calculated from the regulated CO2 emissions of the development after all proposed energy efficiency measures and any CO2 reduction from non-renewable decentralised energy (e.g. CHP) have been incorporated

8.28 Monitoring. The installation of monitoring equipment in all major developments will provide important information showing actual energy performance and will aid the Council's and developers' understanding of the effectiveness of measures implemented in the borough. Such data would also inform the Council as to whether policy requirements are being met. Monitoring shall include any renewable or low carbon technology that contributes to meeting London Plan Policy 5.2.

Policy CC2 - Adapting to climate change

The Council will require development to be resilient to climate change.

All development should adopt appropriate climate change adaptation measures such as:

a. the protection of existing green spaces and promoting new appropriate green infrastructure;

b. not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems;

c. incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and

d. measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy. Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

e. ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;

f. encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;

g. encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment; and

h. expecting non-domestic developments of 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019.

8.37 Sustainable drainage and biodiversity. To support a sustainable approach to drainage, all development should install green roofs, permeable landscaping, green walls and combination green and blue roofs, where appropriate. Further information on these systems can be found in our supplementary planning document Camden Planning Guidance on sustainability

8.41 Cooling. All new developments will be expected to submit a statement demonstrating how the London Plan's 'cooling hierarchy' has informed the building design. Any development that is likely to be at risk of overheating (for example due to large expanses of south or south west facing glazing) will be required to complete dynamic thermal modelling to demonstrate that any risk of overheating has been mitigated.

8.42 Active cooling (air conditioning) will only be permitted where dynamic thermal modelling demonstrates there is a clear need for it after all of the preferred measures are incorporated in line with the cooling hierarchy.

8.50 The Home Quality Mark, launched 2015, is one way of demonstrating the standard of a new residential dwelling, which includes measures for low CO2, sustainable materials, good air quality and natural daylight. The Council will strongly encourage schemes to use the Home Quality Mark. The use of Passivhaus standard is also encouraged in demonstrating energy efficient design. Further details on energy efficient design and principles and Passivhaus are set out in our supplementary planning document Camden Planning Guidance on sustainability.

Local Plan Policy CC1 requires all major developments to assess the feasibility of connecting to an existing decentralised energy network.

Policy CC3 - Water and flooding

We will require development to:

a. incorporate water efficiency measures;

b. avoid harm to the water environment and improve water quality;

c. consider the impact of development in areas at risk of flooding (including drainage);

d. incorporate flood resilient measures in areas prone to flooding;

e. utilise Sustainable Drainage Systems (SuDS) in line with the drainage hierarchy to achieve a greenfield run-off rate where feasible; and

f. not locate vulnerable development in flood-prone areas.

8.55. Residential developments will be expected to meet the requirement of 110 litres per person per day (including 5 litres for external water use).

Policy CC4 Air quality

The Council will ensure that the impact of development on air quality is mitigated and ensure that exposure to poor air quality is reduced in the borough

8.83 A development can affect air quality in three significant ways:

- emissions from construction and demolition;
- emissions from the combustion of fuel for energy within the building; and
- emissions from transport to and from the building.

Policy CC5 Waste

We will:

a. aim to reduce the amount of waste produced in the borough and increase recycling and the reuse of materials to meet the London Plan targets of 50% of household waste recycled/composted by 2020 and aspiring to achieve 60% by 2031;

b. deal with North London's waste by working with our partner boroughs in North London to produce a Waste Plan, which will ensure that sufficient land is allocated to manage the amount of waste apportioned to the area in the London Plan;

c. safeguard Camden's existing waste site at Regis Road unless a suitable compensatory waste site is provided that replaces the maximum throughput achievable at the existing site; and

d. make sure that developments include facilities for the storage and collection of waste and recycling.

8.98 Waste Management Plan. To ensure an integrated approach to waste management and the highest possible reuse and recycling rates, the Council will encourage the submission of a site waste management plan prior to construction. For further details please refer to our supplementary planning document Camden Planning Guidance on sustainability

Camden have also developed a series of guidance documents e.g.

SUMMARY OF KEY POLICY

1. Low Carbon Emissions. For major schemes, 'Zero Carbon' residential. 35% improvement in regulated CO_2 emissions over the Target Emission Rate (TER) outlined in the national Building Regulations 2013 for both residential and commercial areas.
2. Renewable Energy. Major development proposals should incorporate renewable energy technology. A 20% contribution to the annual energy demand of the entire scheme should be targeted where feasible.
3. Low Water Use. Residential development should be designed so that mains water consumption would meet a target of 105 litres or less per head per day, excluding an allowance of 5 litres or less per head per day for external water use.

3 DESIGN APPROACH

SUSTAINABILITY DESIGN APPROACH AND STRATEGY

Sustainability is integral to the design, construction, operation and performance of the proposed development.

Sustainable Development means creating high quality, functional spaces that support health and well-being as well as social and environmental development whilst at the same time addressing key long-term issues such as those capture by the Mayor's strategic targets as set out below.

The proposal actively addresses each aspect and is summarised as follows:

Mayor's Strategic Targets (Sustainable Development)	Sustainability Strategy **(How the proposed development contributes to Mayor's Targets)**
CLIMATE CHANGE AND ENERGY (CO_2 EMISSIONS) London will be a zero carbon city by 2050, with energy efficient buildings, clean transport and clean energy. By 2050 London to have 2GW of solar PV installation.	✓ Very low carbon development (45.4% below Part L). ✓ Ground source heat pump with underfloor heating to maximise efficiency. ✓ MHVR with heat recovery bypass for assisted summer-time night-cooling when required. ✓ Solar PV with integrated batteries.
GREEN INFRASTRUCTURE /BIODIVERSITY London will be the world's first National Park City, where more than half of its area is green, where the natural environment is protected, and where the network of green infrastructure is managed to benefit all Londoners.	✓ Local landscaping (see landscape reporting for details) ✓ Green roofs of extensive type comprising low maintenance grasses, mosses and herbs, to offer higher biodiversity value than common sedum types. Based on 120mm substrate. See location on Figure 5 below
AIR QUALITY London will have the best air quality of any major world city by 2050, going beyond the legal requirements to protect human health and minimise inequalities. A City Hall commissioned report estimated that over 9,000 Londoners died prematurely from long-term exposure to air pollution in 2010 with a £3.7billion cost of air pollution to the London Economy.	✓ Heat pumps to avoid local fossil fuel burning. ✓ Mechanical ventilation with heat recovery (MVHR) offers a means for occupants to filter fresh air. ✓ Fresh air taken at higher levels where pollution concentrations will be lower. ✓ Electric car charger and cycle storage to move away from diesel and petrol combustion.
ADAPTING TO CLIMATE CHANGE London and Londoners will be resilient to severe weather and longer-term climate change impacts. This will include flooding, heat risk and drought. The heat island effect in dense urban areas increases discomfort and energy use (for cooling). With continued climate change this is expected to become a significant issue.	✓ Rainwater harvesting to reduce surface runoff. ✓ Green areas on site will mitigate flood risk. ✓ Local trees provide external shading. ✓ Low risk overheating design, night cooling of exposed thermal mass can be used. ✓ Green roof and solar PV to help protect roof from direct solar – see figure 5 below.
NOISE Londoners' quality of life will be improved by reducing the number of people adversely affected by noise and promoting more quiet and tranquil spaces.	✓ No additional noise sources
WASTE / RECYCLING London will be a zero waste city. By 2026 no biodegradable or recyclable waste will be sent to landfill and by 2030 65 per cent of London's municipal waste will be recycled.	✓ Construction, demolition and excavation waste recycling requirement in contractor specification (construction waste management plan).

Table 5: Sustainability strategy in relation to Mayor's Strategic Targets (May 2018)

Additional aspects related to sustainable development are summarise below:

Additional sustainable development Issues	Sustainability Strategy
WATER USE On average Londoners use approximately 167 l/p.day (litres of potable water per person per day). This is 14% more than the England and Wales average, despite London already being in one of the driest parts of the country. Part G of building regulation requires 125 l/p.day and 110 l/p.day where required by planning condition such as in London (105 litres or less per head per day excluding an allowance of 5 litres or less per head per day for external water consumption)	✓ Rainwater harvesting or grey water collection for WC flushing and irrigation. ✓ Low flow taps, showers, WCs and dishwashers / washing machines as required in line to meet the target of 105 litres or less per head per day excluding an allowance of 5 litres or less per head per day for external water consumption.
Electric Vehicle Charging Points Generally all developments are encouraged to ensure that 1 in 5 parking spaces (both active and passive) provide an electrical charging point.	✓ Electric vehicle charging point
SUSTAINABLE URBAN DRAINAGE Surface water flooding happens when the ground and rivers cannot absorb heavy rainfall and when man-made drainage systems have insufficient capacity to deal with the volume of rainfall. In London when it rains heavily, the sewer interceptors overflow 60 times a year, releasing 39 million cubic metres/tonnes of diluted but untreated sewage into the Thames. Typically this type of flooding is localised and happens very quickly, making it very difficult to predict and give warnings. With climate change predicting more frequent short-duration, high intensity rainfall and more frequent periods of long-duration rainfall, coupled with an ageing Victorian sewer system and increasing pressure from growing populations, surface water flooding is likely to be an increasing problem.	London Plan drainage hierarchy is available to minimise drainage needs: • store rainwater for later use • use infiltration techniques, such as porous surfaces in non-clay areas • attenuate rainwater in ponds or open water features for gradual release to a watercourse • attenuate rainwater by storing in tanks or sealed water features for gradual release to a watercourse • discharge rainwater direct to a watercourse • discharge rainwater to a surface water drain • discharge rainwater to a combined sewer ✓ Rainwater harvesting to limit the discharge to drains. The stored rainwater will be used for toilet flushing and irrigation. ✓ Hardstanding will be porous. ✓ Green roof to manage water flow on low-level roofs

Table 6: Further sustainability aspects

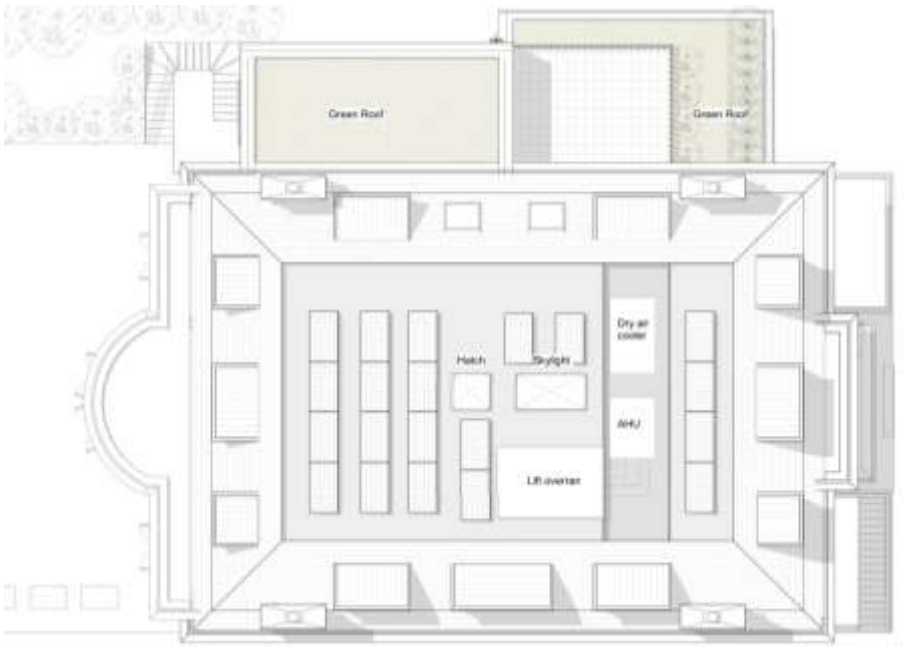


Figure 5: Green roof and solar PV location

ENERGY DESIGN APPROACH – THE ENERGY HIERACHY

The energy hierarchy, as referred to in the London Plan and illustrated below, sets out a three-stage approach to strategic decision-making for the reduction of energy and associated carbon emissions.

BE GREEN - Use Renewable Energy

Energy supply derived from local renewable resources including solar irradiation, wind energy, hydropower and local heat sources such as geothermal energy. Provision of non-local options can also be considered.

BE CLEAN - Deliver Energy Efficiently

Efficient energy provision for space heating and cooling infrastructure e.g. high efficiency cooling plant, combined heat and power (CHP) or, if available, connection to a district heating/cooling networks.

BE LEAN - Minimise Energy Demand

Passive design such as optimising form, orientation and site layout, natural ventilation with thermal mass, daylight and solar shading as well as active design measures such as LED lighting and efficient mechanical ventilation with heat recovery.

Figure 6: Energy Hierarchy Methodology

This approach aims to reduce the energy consumption and consequent carbon emissions of the development while maintaining quality and without compromising occupant wellbeing and comfort.

This is achieved by developing design strategies that respond to the opportunities and challenges of the site within the context of the local climate and environment as well as implementing a highly-efficient energy infrastructure that integrates on-site renewable energy sources.

4 BASELINE CALCULATIONS

Energy demand and annual carbon emissions for dwellings are calculated using BRE accredited energy compliance software such as Stroma for SAP 2012.

The amount of carbon emission reductions achieved by the proposed scheme is compared to the notional Target Emission Rate (TER) which forms the baseline comparison target. This notional building/dwelling is produced by the energy model and intends to replicate the actual building in terms to area, form, orientation and usage. The fabric parameters and system efficiencies for this notional building meets and, in some parts, exceeds the minimum requirements for compliance with Part L of the 2013 Building Regulations as summarised in the table below.

For dwellings, as part of the 2013 Part L (Part L1A) of the building regulations, the Target Fabric Energy Efficiency (TFEE) sits alongside TER. The TFEE is the minimum fabric energy performance requirement for a new dwelling. The Dwelling Fabric Energy Efficiency (DFEE) rate is the actual fabric energy performance of the new dwelling. The DFEE must not exceed the TFEE. It is expressed as the amount of energy demand in kWh/(m^2.year). The TFEE is 15% higher than the notional FEE and so if the actual dwelling is constructed entirely to the notional dwelling specifications it will meet the fabric energy efficiency targets. However, the notional dwelling is not prescriptive and specifications can be varied provided that the TFEE rate is achieved or bettered. To prevent poor performance of individual elements, limiting fabric values are retained in Table 2 of approved document L1A and limiting building services efficiencies are set out in the Domestic Building Services Compliance Guide.

The Notional Building baseline requirements are:

Element	Building Regulations 2013 for domestic	
	U Value W/m^2K	G Value
External Walls	0.18	-
Floor	0.13	-
Roof	0.13	-
Windows	1.4	0.63
External Opaque Doors	1.0	-
External Glazed Doors	1.2	-
Air Tightness	5.0 m3/m2/h @50Pa	
Liner thermal transmittance	Standardised Psi values SAP Appendix R	
Size of building	Same as proposed dwelling	
Opening areas (windows and doors)	Same as actual dwelling up to 25% of total floor area	
Ventilation type	Natural with extract fans	
Air-conditioning	None	
Heating source	Mains Gas (89.5% SEDBUK 2009)	
Heating emitters and controls	Radiators. Time and temperature zone control. Weather compensation.	
Hot water storage	Gas boiler heated. Thermostat control. 150 litres. Separate time control.	
Lighting	100% low energy lighting	
Thermal Mass parameter (TMP)	Medium (250kJ/m^2K)	

Table 7: Notional Dwelling (Building) Specification (Table 4 SAP 2012)

The baseline CO_2 emissions associated with regulated energy consumption are given below for each dwelling. “Regulated” energy means space heating, hot water, cooling, lighting, pumps and fans where as “unregulated” energy covers other uses such as appliances, equipment and cooking.

Following this first step of the analysis, which details the baseline notional building CO_2 emissions, the “Be Lean”, “Be Clean” and “Be Green” scenarios are presented for comparison.

Accommodation	TER ($kg.CO_2/m^2/yr.$)
79 Avenue Road	14.23

Table 8: Baseline Dwelling Regulated Carbon Emissions

5 “BE LEAN”

The incorporation of appropriate passive and active energy efficiency measures can significantly reduce energy demands. These measures are often integral to the building form and fabric and cannot be readily remedied or retrofitted once the building has been constructed.

The augmentation of these design strategies begins by identifying site-specific challenges and opportunities, considering the microclimate, location and surroundings and applying them to the building form, façade and orientation.

CLIMATE ANALYSIS

The London climate is heating dominated, hence the key passive measure to be implemented are high levels of insulation and air-tightness. Temperatures in the summer can occasionally rise above comfortable levels and this will tend to intensify as a consequence of the climate change and further urbanisation.

The diurnal temperature variations are high with an average daily temperature swing of 8-10°C even during peak summer. This creates potential for passive summertime cooling using night-time cooling via openable windows or mechanical ventilation.

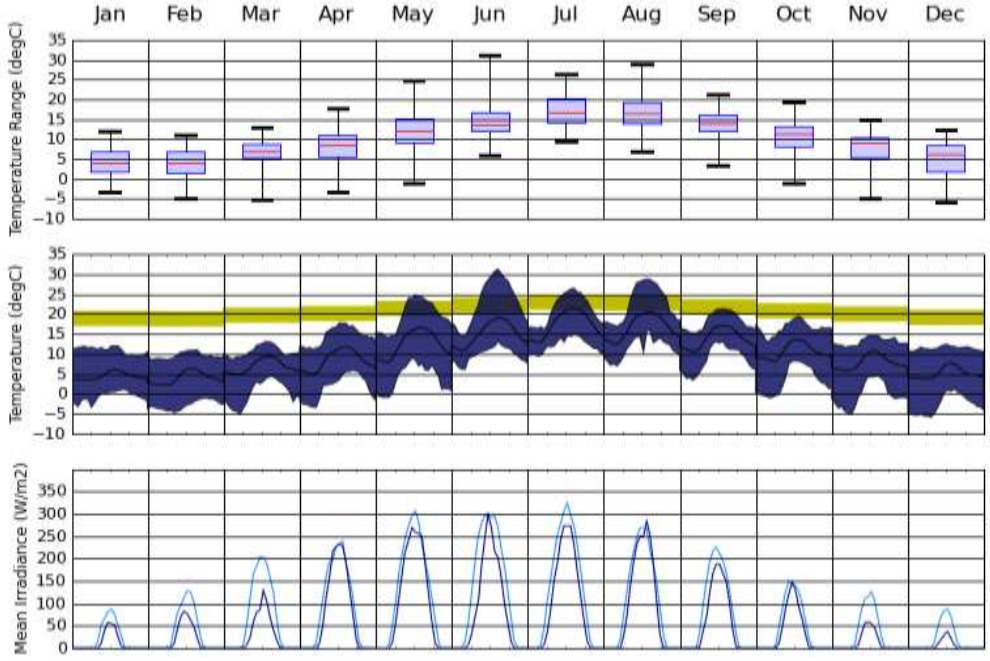


Figure 7: Average historic climate data for London

BUILDING FABRIC PERFORMANCE & INSULATION

High levels of insulation are proposed as summarised later in this section. The thermal performance of all exposed elements equals or exceeds the minimum requirements for Building Regulations 2013. This will significantly reduce energy consumption and ensure optimum occupant comfort all year round by retaining heat in the winter and reducing heat gains in the summer.

This is particularly relevant for glazed surfaces that can be a cause of overheating in summer or overcooling and condensation formation in winter. Highly-insulated glazing will also improve occupant comfort by reducing radiant temperature asymmetry which can be a comfort issue especially during the winter months.

AIR TIGHTNESS & INFILTRATION

A low target air-permeability rate has been selected as summarised later in this section. The key to achieving good air-tightness is the build quality of construction. Selection of Accredited improves air-tightness of the building envelope in practice. Testing procedures shall be performed in accordance with the recommendations set out in CIBSE TM 23 and the ATTMA TS1.

THERMAL BRIDGING

Minimising thermal bridging is an important aspect of the design. The approach to limiting thermal bridging is to implement Accredited Details where viable.

www.planningportal.co.uk/info/200135/approved_documents/74/part_l_-_conservation_of_fuel_and_power/6

SOLAR EXPOSURE AND DAYLIGHT

Maximising exposure to solar energy and daylight is essential to reduce reliance on artificial lighting, reducing winter daytime heating requirements and to contribute to the general wellbeing of occupants.

The site has excellent access to solar energy and natural daylight, as there are no surrounding buildings that overshadow. This makes the development roofs highly suitable for solar energy harvesting.

Fenestration on the facades are sized and located to maximise natural daylight to provide amenity and reduce artificial lighting energy use. Internal shading will be incorporated to minimise the risk of overheating and glare without overly compromising daylight availability.

The central atrium also allows additional light deep into the core of the building in order to reduce the requirement for artificial lighting and to enhance occupant well being.

NATURAL VENTILATION

A central daylit atrium is provided with openable rooflight to allow for stack-assisted natural ventilation across all floors. Stack-assisted ventilation is one of the best forms of promoting ventilation naturally and will allow for night cooling of the interior thermal mass in the summer months to reduce over-heating and the requirement for active cooling.

ACTIVE BUILDING SERVICES SYSTEMS

All building services systems will be in accordance with, and where possible exceed, the energy minimum requirements of efficiency outlined in the Building Service Compliance Guide 2013.

The heating and hot water distribution will be provided by the ground source heat pump with a back-up gas boiler to take the domestic hot water intermittently to 60°C to protect against legionella.

The dwelling will benefit from high-efficiency (low specific fan power) zoned mechanical ventilation system with heat recovery. This will ensure high air quality at the lowest energy requirement.

Low-energy fixed lighting, generally comprising of high efficacy LED fittings will be installed throughout the development with timer, daylight and motion-sensor control as appropriate.

COOLING AND OVERHEATING

The cooling and overheating strategies are summarised in the table below using the cooling hierarchy which has been applied to the design.

Hierarchy Measure	Application to proposed development
1. MINIMISE INTERNAL HEAT GAINS	✓ Low energy LED lighting.
2. MINIMISE EXTERNAL HEAT GAINS	✓ High level of insulation. ✓ Internal blinds with light coloured external facing surfaces
3 & 4 HEAT MANAGEMENT AND PASSIVE VENTILATION	✓ Each room will have access to openable window areas in line with building regulations purge ventilation requirements. ✓ Central atrium to provide stack ventilation and enable night cooling of exposed thermal mass.
5. MECHANICAL VENTILATION	✓ Central mechanical ventilation is specified.
6. ACTIVE COOLING	✓ Available from ground-source system if required

Table 9: Cooling and overheating hierarchy application

BE LEAN SUMMARY

As part of the "Be Lean" approach, seeking to minimise energy demand, the building fabric has been specified to meet or exceed the minimum fabric parameters outlined in Part L of the Building Regulation 2013 as per table below.

Element	Building Regulations 2013 Notional Building (limit)		Enhanced Building Fabric Improvement for the proposed development	
	U Value (W/m^{2}K)	G Value	U Value (W/m^{2}K)	G Value
External Walls	0.18 (0.3)	-	0.13 (0.2 below ground)	-
Ground Floor	0.13 (0.25)	-	0.12	-
Roof	0.13 (0.20)	-	0.11	-
Windows	1.40 (2.0)	0.63	1.2	0.63
External Doors	1.0	-	1.0	-
External Glazed Doors	1.2	-	1.2	-
Air Tightness	5.0 m^3/m^2/h (10)		3.0 m^3/m^2/h	
Thermal Bridging	Accredited details		Accredited details where possible. As a minimum cills, jambs and lintels, intermediate floors and corners.	
Air-conditioning	None		In principal rooms via ground source heat pump main system	
Space heating	Mains Gas (89.5% SEDBUK 2009)		Ground source heat pump e.g. Dimplex Si 22TU ground to water (winter efficiency 454%)	
Hot water	Mains Gas (89.5% SEDBUK 2009)		Ground source heat pump e.g. Dimplex Si 22TU ground to water (winter efficiency 454%). Mains Gas (93.5% SEDBUK 2009). Cylinder loss 4kWh/d.	
Heating emitters	Radiators		Underfloor heating	
Heating control	Time and temperature zone control.		Time and temperature zone control with weather compensation	
Lighting	100% low energy lighting		100% low energy lighting	
Ventilation type	Natural with extract fans		Distributed Mechanical Ventilation with Heat recovery (SFP 1.0, efficiency 83%)	

Table 10: Proposed development and baseline comparison "Notional" SAP building

"Be Lean" Carbon Emissions for Dwellings

The CO_2 emissions associated with the Be Lean regulated energy consumption are given below.

Accommodation	TER ($kg.CO_2/m^2/yr.$)	LEAN DER ($kg.CO_2/m^2/yr.$)
79 Avenue Road	14.23	14.22

Table 11: Be Lean Dwelling Regulated Emissions

6 “BE CLEAN”

CENTRAL HEAT SYSTEM

The scheme makes use of a central heat system to provide heating and hot water.

CONNECTION TO THIRD-PARTY HEAT NETWORKS

Connection to heat networks has been stated as a policy priority. The London Heat Map is available to help determine feasibility. This map shows that the proposed development is very far away from existing of potential heat networks (See Appendix B). Therefore, connection to third party heat networks are not considered viable for this development.

However, the presence of a central heat system may allow for a future connection should a viable connection become available.

GAS FIRED COMBINED HEAT AND POWER (CHP)

Combined heat and power (CHP) systems are available for individual houses, group residential units and small non-domestic premises. Large commercial CHPs are also found in premises which have a simultaneous demand for heat and electricity for long periods, such as hospitals, recreational centres, hotels and multi-residential and mix-use developments.

Whilst MicroCHP units are available for small developments CHP is not generally recommended and GLA guidance suggests following need not install CHP:

- Small-medium residential development (less than 500 apartments)
- Non-domestic developments with a simultaneous demand for heat and power less than 5000 hours per annum (offices/schools)

Therefore, CHP is not considered a viable option for this development.

7 "BE GREEN"

A renewable energy feasibility exercise has been carried out in order to determine the most viable option(s) that would allow the proposal to achieve the renewable energy target of 20% CO_2 reduction relative to the overall energy demand requirements.

The study is summarised in Appendix C. The viable technology options, ground source heat pumps and solar PV is summarised below.

HEAT PUMPS

Technical Overview

Heat pumps operate by extracting heat energy from the surrounding air/ground or water and transferring that energy in the form of higher-grade heat into a building using underfloor heating or radiator systems.

An electrical ground source heat pump can deliver in around 4kW of thermal energy for every 1kW of grid supplied electricity used (4:1 ratio). Under the principles of a vapour compression cycle using a refrigerant, an ASHP can provide both space heating and cooling. The system involves a compressor and a condenser to absorb heat from one space and deliver it to another. This is referred to as a reverse-cycle air conditioning system and is commonly used with a variable refrigerant flow system (VRF) which can provide simultaneous space heating and comfort cooling to a development. Generally, these systems require very low maintenance.

Heat pump technology will provide all space heating requirements and majority of hot water needs and will work well with the proposed solar PV installation. The bore holes will have no negative visual or acoustic impact.

PHOTOVOLTAICS

Technical Overview

Solar photovoltaic (PV) modules convert sunlight into electricity. PV is distinct from other renewable energy technologies since it has no moving parts to be maintained and is silent. PV systems can be incorporated into buildings in various ways such as on sloped or flat roofs, in facades, atria and as shading devices. Costs have fallen dramatically in recent years as a result of growing global uptake and continue to fall.

Applicability to the Proposed Scheme

Due to the available unshaded roof area of the proposed development, PV systems would be a suitable technology for deployment. An advantage of solar PV over other types of low and zero carbon technologies, is that the running costs and maintenance requirements are very low.

The roof top photovoltaic panels are orientated to the south-west. The panels will be installed with a tilt angle of up to 30° to allow for self-cleaning (via rainfall) and a 6.3kW installation is proposed.

"Be Green" Carbon Emissions for Dwellings

The CO_2 emissions associated with the Be Green regulated energy consumption are given below.

Accommodation	Baseline TER ($kg.CO_2/m^2/yr.$)	LEAN DER ($kg.CO_2/m^2/yr.$)	GREEN DER ($kg.CO_2/m^2/yr.$)
79 Avenue Road	14.23	14.22	7.77

Table 12: Be Green summary

8 SUMMARY

The predicted total annual CO_2 emissions of the proposed development following the introduction of energy efficiency measures, passive and active design (Be Lean) and renewable energy systems (Be Green) saves 9.87 tonnes.CO_2/yr compared to the Building Regulations Part L (2013) compliant building of 21.74 kgCO_2/yr. This represents an improvement in carbon emissions equating to a reduction of 45.4%.

Carbon Emissions Summary

	Carbon dioxide emissions for dwelling (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 (Building Regulations) Compliance	21.74	20.44
After "Be Lean" (energy demand reduction)	21.73	20.44
After "Be Clean" (heat network / CHP)	21.73	20.44
After "Be Green" (renewable energy)	11.87	20.44

Table 13: Summary of "Be Green" Carbon Emissions and Baseline Comparison

This performance can be expressed as savings between each stage in the energy hierarchy.

	Regulated carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from "Be Lean" (energy demand reduction)	0.02	0.1%
Savings from "Be Clean" (heat network / CHP)	0.00	0.0%
Savings from "Be Green" (renewable energy)	9.86	45.3%
Total cumulative on-site savings	9.87	45.4%
Shortfall to 35% below Part L (annual)	11.87	
Shortfall over 30 years	356	
Carbon Offset Fund (@£60/tonne[3])	£ 21,371	

Table 14: Dwelling regulated CO2 emissions savings after each stage of the Energy Hierarchy.

[3] "From October 2016…the Council considers £1,800 per tonne of carbon (30 years) to be appropriate (both residential and non-residential development)"

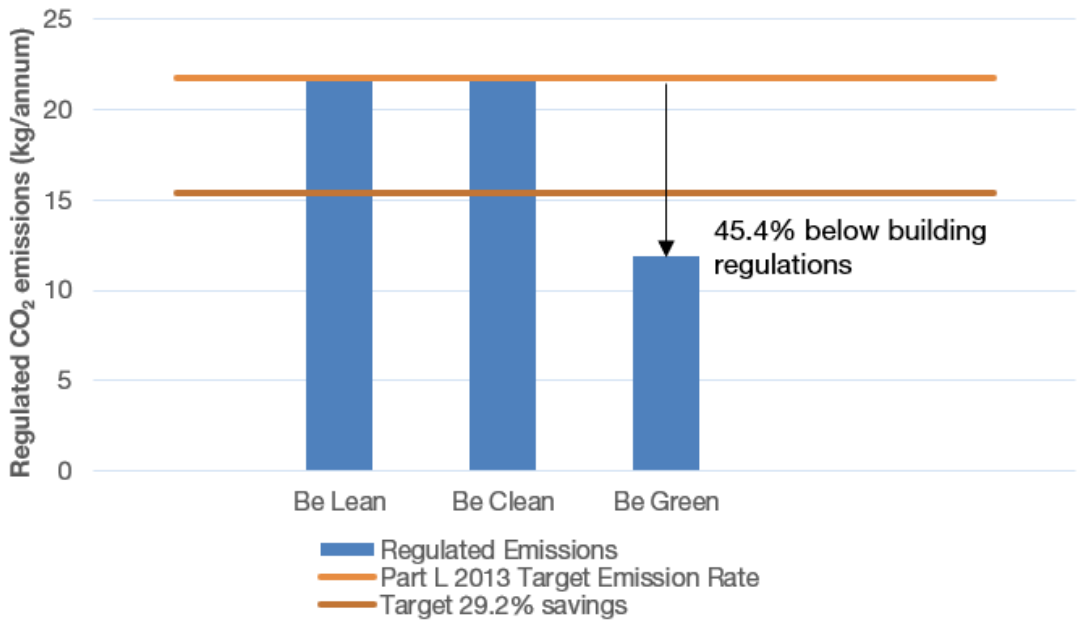


Figure 8: Summary of the dwelling regulated energy use as compared to the CO_2 emission baseline

The total regulated "Be Lean" CO2 emissions is 21.73 tonne.CO_2/yr, whereas the total regulated "Be Green" CO2 emissions are 11.87 tonne.CO_2/yr. Therefore, the annual renewable energy contribution equates to 45% of the total carbon emissions.

A rainwater harvesting or grey water collection will be included for WC flushing and irrigation as well as low flow taps, showers, WCs and (where fitted) dishwashers / washing machines where possible to meet the higher water use target of 105 litres / person / day or less (excluding an allowance of 5 litres or less per head per day for external water consumption).

The residence also benefits from very good links to low energy public transportation, e.g. Swiss Cottage and South Hampstead stations (the site achieves a high PTAL score of 4).

APPENDIX A: EPC OF EXISTING BUILDING (EPC F)

Energy Performance Certificate

HM Government

79, Avenue Road, LONDON, NW8 6JD

Dwelling type:	Detached house	**Reference number:**	0456-2804-7377-9693-5045
Date of assessment:	14 March 2017	**Type of assessment:**	RdSAP, existing dwelling
Date of certificate:	14 March 2017	**Total floor area:**	419 m²

Use this document to:

- Compare current ratings of properties to see which properties are more energy efficient
- Find out how you can save energy and money by installing improvement measures

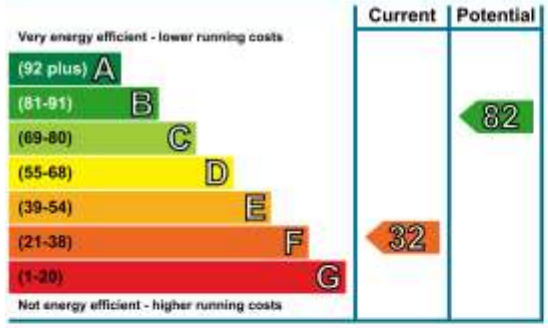
Estimated energy costs of dwelling for 3 years:	**£ 17,460**
Over 3 years you could save	**£ 12,408**

Estimated energy costs of this home

	Current costs	Potential costs	Potential future savings
Lighting	£ 846 over 3 years	£ 432 over 3 years	You could save £ 12,408 over 3 years
Heating	£ 16,029 over 3 years	£ 4,236 over 3 years	
Hot Water	£ 585 over 3 years	£ 384 over 3 years	
Totals	**£ 17,460**	**£ 5,052**	

These figures show how much the average household would spend in this property for heating, lighting and hot water and is not based on energy used by individual households. This excludes energy use for running appliances like TVs, computers and cookers, and electricity generated by microgeneration.

Energy Efficiency Rating



The graph shows the current energy efficiency of your home.

The higher the rating the lower your fuel bills are likely to be.

The potential rating shows the effect of undertaking the recommendations on page 3.

The average energy efficiency rating for a dwelling in England and Wales is band D (rating 60).

The EPC rating shown here is based on standard assumptions about occupancy and energy use and may not reflect how energy is consumed by individual occupants.

Top actions you can take to save money and make your home more efficient

Recommended measures	Indicative cost	Typical savings over 3 years
1 Increase loft insulation to 270 mm	£100 - £350	£ 1,278
2 Flat roof or sloping ceiling insulation	£850 - £1,500	£ 441
3 Room-in-roof insulation	£1,500 - £2,700	£ 1,989

See page 3 for a full list of recommendations for this property.

To receive advice on what measures you can take to reduce your energy bills, visit www.simpleenergyadvice.org.uk or call freephone **0800 444202**. The Green Deal may enable you to make your home warmer and cheaper to run.

Page 1 of 4

APPENDIX B: HEAT NETWORK STUDY

The output from the London Heat Map tool is given below.

https://www.london.gov.uk/what-we-do/environment/energy/london-heat-map/view-london-heat-map

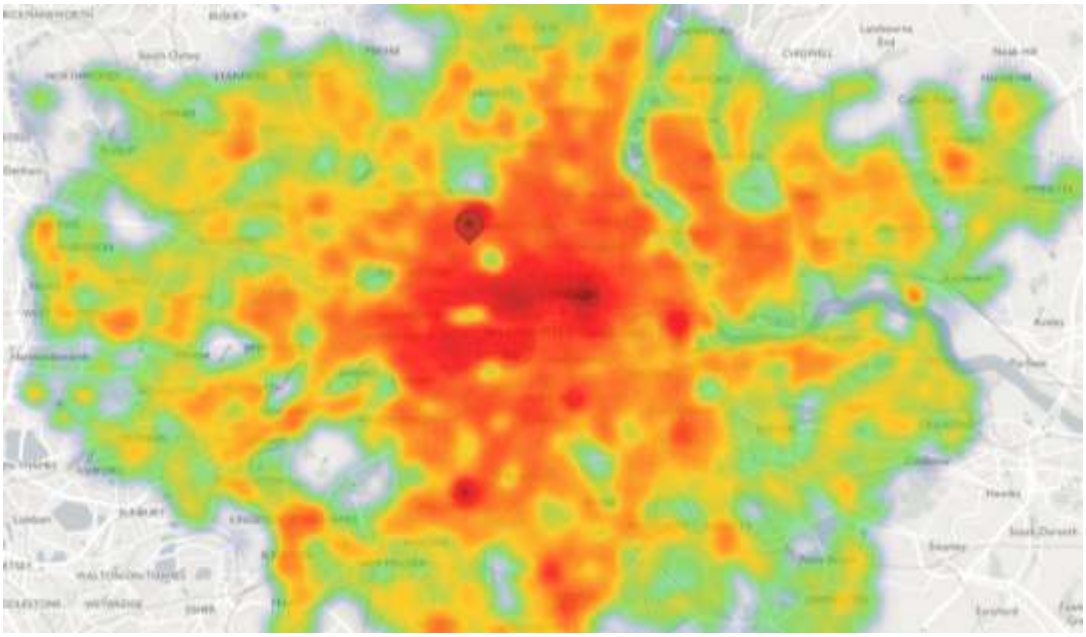


Figure B1: London Heat Map tool showing the location of the site in relation to heat use density

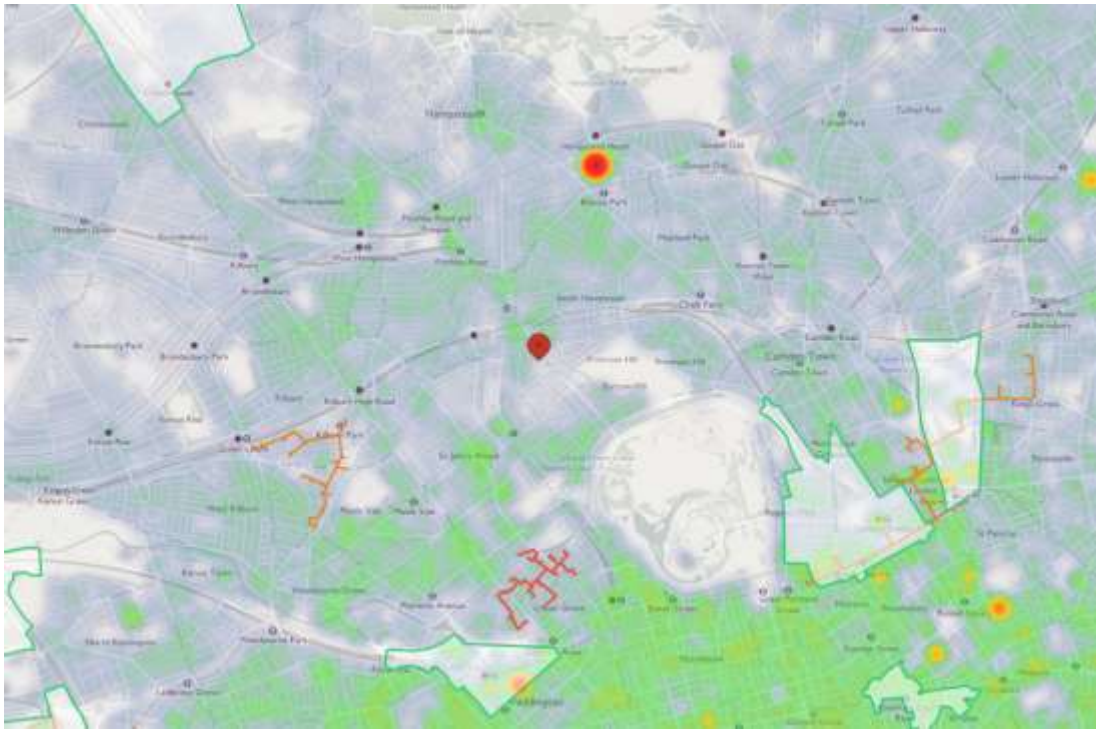


Figure B2: London Heat Map tool showing existing heat networks in red line, proposed heat networks in orange and Opportunity Area Planning Framework zones outlined in green

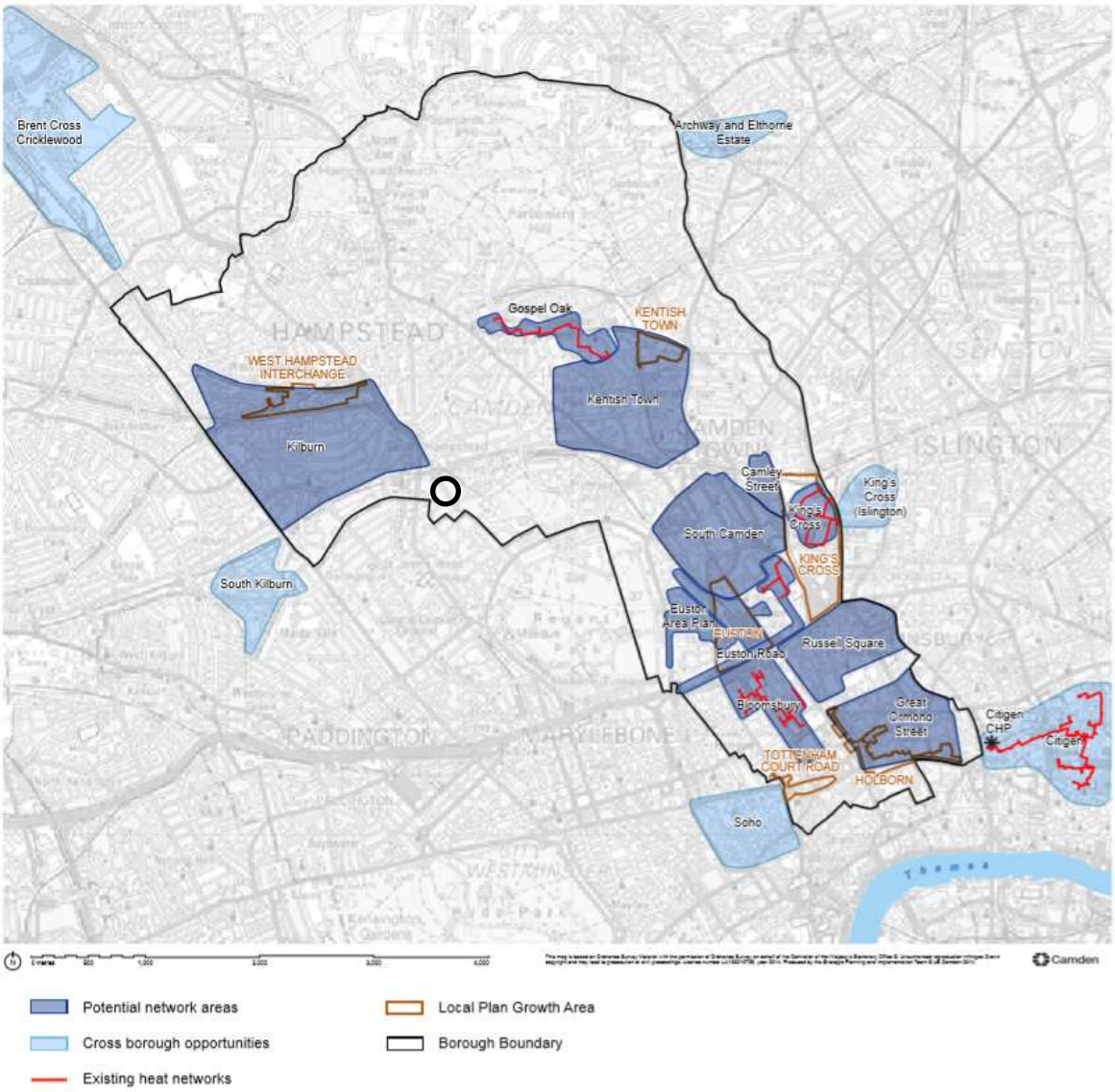


Figure B3: Map 5: Energy Networks from Camden's Local Plan 2017

APPENDIX C: TECHNOLOGY FEASIBILITY STUDY SUMMARY

The overall summary of the renewable energy feasibility exercise is presented below.

	Technology		Assessment / Viability
	Wind Power	Wind turbine installed on the roof of the development.	Due to the proximity to residential areas, the high cost per kW for smaller building-mounted turbines and the impacts in terms of visual noise and shadow flicker, wind turbines are not considered a viable technology for the development. CONCLUSION: NOT CONSIDERED FEASIBLE
	Ground Source Heat Pumps	Open or closed loop GSHP system requiring extraction of ground water and / or deep boreholes.	Best performing, reliable low-carbon heating technology. Low maintenance and no external visual or noise impact. System can use solar PV electricity. High cost for bores holes. space requirements for plant. However basement area is available to locate the heat pump, buffer tanks and pump sets. CONCLUSION: CONSIDERED FEASIBLE
	Air Source Heat Pumps	Electric powered external plant serving each unit providing heating and cooling	Low maintenance. System can use solar PV electricity. Lower efficiency than ground source heat pumps. Noise and visual impacts considerations can be important. Considered feasible but ground source preferred. CONCLUSION: NOT SELECTED
	Solar Thermal Collectors	Roof-mounted solar thermal panels providing hot water heating	Roof areas have good potential for solar thermal energy collection. Solar hot water collectors would be able to provide a significant proportion of domestic hot water demand of the development. However, PV modules are favoured due to the low maintenance requirements. CONCLUSION: NOT SELECTED
	Solar Photovoltaic Panels	Roof mounted Photovoltaic panels (PV) provide electricity directly to the scheme, exporting any surplus production to the grid.	Some roof areas have good potential for solar power generation. PV has low maintenance requirements. PV electricity is clean and zero-carbon and will offset carbon intensive grid power. CONCLUSION: CONSIDERED FEASIBLE
	Combined Heat & Power (CHP)	Gas powered turbine generating electricity on site. Waste heat is also made available for on-site use	Not suitable for low hot water demand scheme. Carbon offsetting potential significantly reduce now that the UK's electricity grid is much cleaner after increase in renewable energy deployment and decrease in coal generation. CONCLUSION: NOT CONSIDERED FEASIBLE
	Energy Storage	Energy Storage e.g. batteries	Battery scheme could be viable to help complement the solar PV installation and provide energy to the heat pump and car charger when the sun is not shining. CONCLUSION: CONSIDERED FEASIBLE
	Biomass Heating	Biomass-fired community heating system.	Biomass heating is an established technology but has high maintenance requirements, fuel storage and delivery issues and is a source of increase in pollution, notably particulates (PM2.5 & 10), SO_2 and NO_X emissions. CONCLUSION: NOT CONSIDERED FEASIBLE

Table C1: Summary of Low and Zero Carbon Study Analysis Results

APPENDIX D: SAMPLE SAP COMPLIANCE DATASHEET (BE GREEN)

BUILDING REGULATION COMPLIANCE
Calculation Type: New Build (As Designed)

Property Reference	014878	Issued on Date	04/12/2019
Assessment Reference	003 - Green	Prop Type Ref	

SAP Rating	89 B	DER	7.77	TER	14.23
Environmental	90 B	% DER<TER	45.40		
CO_2 Emissions (t/year)	9.98	DFEE	56.83	TFEE	67.82
General Requirements Compliance	Pass	% DFEE<TFEE	16.20		

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	14.23	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	7.77	$kgCO_2/m^2$	Pass
	-6.46 (-45.4%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	67.82	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	56.83	$kWh/m^2/yr$	
	-11.0 (-16.2%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.16 (max. 0.30)	0.20 (max. 0.70)	Pass
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	Pass
Roof	0.11 (max. 0.20)	0.11 (max. 0.35)	Pass
Openings	1.19 (max. 2.00)	1.20 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	3.00 (design value)	$m^3/(h.m^2)$ @ 50 Pa	
Maximum	10.0	$m^3/(h.m^2)$ @ 50 Pa	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Dimplex SI 22TU	

BUILDING REGULATION COMPLIANCE
Calculation Type: New Build (As Designed)

Secondary heating system	None		
5 Cylinder insulation			
Hot water storage	Measured cylinder loss: 4.00 kWh/day Permitted by DBSCG 6.10		Pass
Primary pipework insulated	Yes		Pass
6 Controls			
Space heating controls	Time and temperature zone control		Pass
Hot water controls	Cylinderstat		Pass
	Independent timer for DHW		Pass
7 Low energy lights			
Percentage of fixed lights with low-energy fittings	100	%	
Minimum	75	%	Pass
8 Mechanical ventilation			
Continuous supply and extract system			
Specific fan power	1.00		
Maximum	1.5		Pass
MVHR efficiency	83	%	
Minimum	70	%	Pass
Criterion 3 – Limiting the effects of heat gains in summer			
9 Summertime temperature			
Overheating risk (Thames Valley)	Not significant		Pass
Based on:			
Overshading	Average		
Windows facing North	14.41 m², No overhang		
Windows facing East	33.21 m², No overhang		
Windows facing South	17.44 m², No overhang		
Windows facing West	52.92 m², No overhang		
Air change rate	8.00 ach		
Blinds/curtains	None		
Criterion 4 – Building performance consistent with DER and DFEE rate			
Air permeability and pressure testing			
3 Air permeability			
Air permeability at 50 pascals	3.00 (design value)	$m^3/(h.m^2)$ @ 50 Pa	
Maximum	10.0	$m^3/(h.m^2)$ @ 50 Pa	Pass

BUILDING REGULATION COMPLIANCE
Calculation Type: New Build (As Designed)

10 Key features

External wall U-value	0.13	W/m²K
External wall U-value	0.13	W/m²K
External wall U-value	0.13	W/m²K
External wall U-value	0.13	W/m²K
Roof U-value	0.11	W/m²K
Roof U-value	0.11	W/m²K
Roof U-value	0.11	W/m²K
Roof U-value	0.11	W/m²K
Floor U-value	0.12	W/m²K
Door U-value	1.00	W/m²K
Thermal bridging y-value	0.033	W/m²K
Air permeability	3.0	m³/m²h
Photovoltaic array	6.30	kW

THERMAL BRIDGING
Calculation Type: New Build (As Designed)

	Junction detail	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E2 Other lintels (including other steel lintels)	Table K1 - Approved	0.300	76.50	22.95	
External wall	E3 Sill	Table K1 - Approved	0.040	63.30	2.53	
External wall	E4 Jamb	Table K1 - Approved	0.050	171.86	8.59	
External wall	E22 Basement floor	Table K1 - Default	0.070	104.42	7.31	
External wall	E6 Intermediate floor within a dwelling	Table K1 - Approved	0.070	237.76	16.64	
External wall	E14 Flat roof	Table K1 - Default	0.080	140.18	11.21	
External wall	E16 Corner (normal)	Table K1 - Approved	0.090	151.36	13.62	
External wall	E17 Corner (inverted – internal area greater than external area)	Table K1 - Approved	-0.090	92.68	-8.34	
External roof	R6 Flat ceiling	Table K1 - Default	0.060	58.00	3.48	

Total: 78.00 **W/mK:**

Y-Value: 0.033 **W/m²K:**